Remarks/Arguments

Applicants respectfully request favorable reconsideration of the subject application, particularly in view of the above amendment and the following remarks. There is no additional fee for the above amendment as the number of independent claims remains unchanged and the total number of claims has been reduced.

Applicants have amended Claim 1 of the subject application by incorporating all of the limitations of Claim 2 into Claim 1. As a result of the amendment to Claim 1, Applicants have canceled Claims 2, 14-16, and 18-23 from the subject application. In addition, Applicants have amended Claims 3, 6-8 and 13, which previously depended from Claim 2, to depend from Claim 1. Applicants respectfully urge that, because the amendment is merely a rewriting of Claim 2 in independent form, this amendment incorporates no new subject matter into the application.

The invention claimed by Applicants is an apparatus comprising a carbonaceous material reactor vessel comprising at least one wall which encloses a reaction space. Disposed within the reaction space are a reaction zone containing a solid carbonaceous material and a product gas zone containing a reaction product gas. The at least one wall forms a carbonaceous material inlet, an hydrogen-rich gas outlet, and a retentate gas outlet. Disposed within the reaction space is at least one

permeable hydrogen-selective membrane having a first side in contact with the reaction product gas and an opposite second side in contact with an hydrogen-rich gas. *The essential feature of this invention is the disposition of a membrane selective for hydrogen permeation in the reaction space of the reactor vessel in which a solid carbonaceous material is converted to a reaction product gas comprising hydrogen* (typically a synthesis gas), as a result of which the generated hydrogen is able to be immediately separated from the other components comprising the reaction product gas. Applicants respectfully urge that the prior art relied upon by the Examiner for rejection of the subject application neither teaches nor suggests an apparatus as claimed by Applicants comprising *a membrane selective for hydrogen permeation disposed inside the reaction space formed by the walls of a carbonaceous material reactor vessel having a reaction zone comprising a solid carbonaceous material.*

Claims 1-4, 6, 8-11, 12-16, 18, and 20-23 have been rejected under 35 U.S.C. 102(b) as being anticipated by Marianowski et al., U.S. Patent 4,810,485 (hereinafter "the Marianowski et al. patent"). This rejection is respectfully traversed. The Marianowski et al. patent teaches a process and apparatus for hydrogen forming in which one side of a hydrogen ion porous and molecular gas non-porous metallic foil is contacted with mixed gases comprising molecular hydrogen formed by a chemical reaction in a hydrogen production zone (Abstract). In support of this

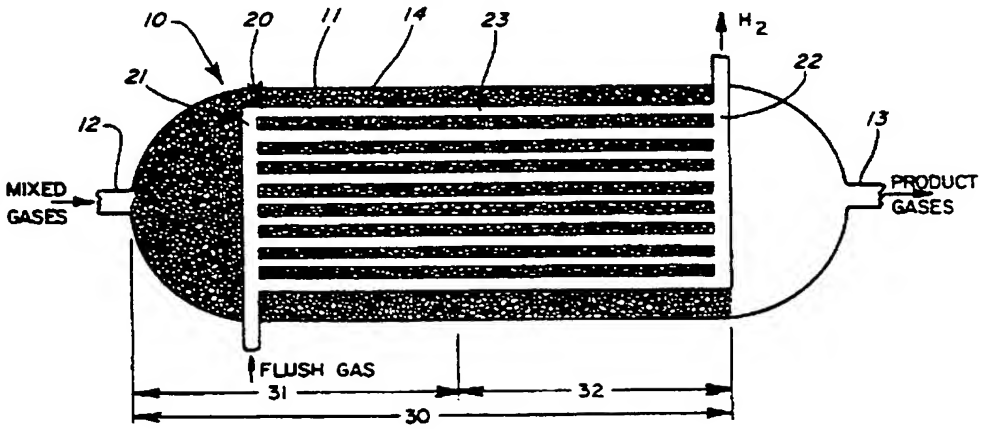
rejection, the Examiner cites Col. 2, lines 59-65 of the Marianowski et al. patent as teaching disposition of a hydrogen ion porous and molecular gas non-porous metallic foil, i.e. permeable hydrogen selective membrane, within a reaction space formed by at least one wall of a carbonaceous material reactor vessel and containing a solid carbonaceous material as claimed by Applicants. Applicants respectfully disagree with the Examiner's interpretation of the teachings of the Marianowski et al. patent.

Col. 2, lines 59-65 of the Marianowski et al. patent states:

> "Hydrogen forming reaction systems particularly suited for this invention are the generic class of steam/-hydrocarbon reforming reactions, such as reforming of methane, propane, ethane, methanol, natural gas and refinery gas; water-gas-shift reactions; and carbonaceous material gasification reactions, such as gasification of coal, pest, and shale."

Applicants respectfully urge that this language does not teach or suggest disposition of a permeable hydrogen selective membrane within a reaction space formed by at least one wall of a carbonaceous material reactor vessel *and* containing a solid carbonaceous material as claimed by Applicants. *The cited language merely indicates that systems suitable for producing hydrogen-containing gases for introduction into and processing in the invention of the Marianowski et al. patent include gasification systems.* That is, the reference to gasification systems is being made in connection with generators and sources of mixed gases containing hydrogen, as well as other gaseous components, to the reactor vessel in which further conversion of hydrogen-

containing components, such as water vapor (See Table II), to hydrogen by various reactions, e.g. water-gas-shift, is carried out. Applicants respectfully urge that there is no teaching or suggestion by the Marianowski et al. patent of the disposition of a solid carbonaceous material in the reactor vessel taught therein as required by Applicants' claimed invention. In addition, Fig. 3, as seen herein below, teaches only the introduction of mixed gases into the reactor vessel of the Marianowski et al. patent.



In addition, Col. 4, line 63 to Col. 5, line 23 describes the reactor vessel of the Marianowski et al. patent as follows:

> "Hydrogen forming reactor 10 is shown in FIG. 3 having reactor casing 11 with supply conduit 12 supplying reactant gases to the interior of reactor casing 11 enclosing catalytic packing 14. The gases supplied through supply conduit 12 may be gases and vapors for reaction in hydrogen producing reactions such as the steam/methane reforming reaction and the water-gas-shift reaction. The reactant gases are passed through catalytic packing 14 for conduct of the hydrogen forming reaction under suitable hydrogen forming reaction conditions within the reactor. It is an advantage of the present process that the feed reactant gases may be, in many instances, fed directly from the upstream processes since the hydrogen forming reactions of the present process are driven by favorable chemical equilibrium and not dependent solely upon temperature and/or pressure conditions to drive the reaction. Hydrogen withdrawal system 20 is placed within reactor 10 in hydrogen production zone 30. FIG. 3 shows hydrogen withdrawal system 20 having inlet manifold 21 and outlet manifold 22 joined by a plurality of hydrogen ion passing metallic foil tubes 23. Hydrogen may be withdrawn through outlet manifold 23 by passage of an inert flush gas introduced through manifold 21 and passed through ion passing metallic foil tubes 23 to flush out the hydrogen or inlet manifold 21 may be closed, or eliminated, and a reduced pressure down to a vacuum may be maintained in outlet manifold 22 to withdraw very pure hydrogen gas."

Applicants respectfully urge that it is clear from this description that *only reactant gases and no solid carbonaceous materials enter the reactor vessel.* Nowhere does

the Marianowski et al. patent teach or suggest the presence or introduction of solid carbonaceous material into the reactor vessel. Furthermore, as described, the reactant gases are passed through a catalytic packing for conduct of the hydrogen forming reaction within the reactor vessel. That is, the operability of the reactor vessel depends upon maintaining the porosity of the catalytic packing material to enable continuous flow of the reactant gases. Applicants respectfully urge that, were solid carbonaceous material being introduced into the reactor vessel as argued by the Examiner, the reactor vessel would quickly become inoperable due to plugging of the catalytic packing material by the solids.

In addition, Col. 5, lines 41-61 states

> "The hydrogen forming reactor 10 may be of any shape, size and material as known to the art for conduct of hydrogen forming reactions at temperatures and pressures desired for the process of this invention. Generally, plant equipment may be significantly reduced by the practice of this invention since in many instances *the mixed gases supplied to the hydrogen forming reaction system of this invention may be supplied directly from upstream processes, such as coal gasification,* without the requirement of temperature adjustment to drive the hydrogen forming reaction. Likewise, conventional downstream hydrogen purification equipment may be eliminated due to the very pure hydrogen withdrawn from the hydrogen forming reaction systems according to the present invention. Generally, the high cost of hydrogen ion permeable metallic foils used in the process of this invention is more than offset by the reduction in other plant equipment and reductions

> in the cost of operating and maintaining such equipment which is eliminated or reduced in size by practice of this invention." (Emphasis added)

Applicants respectfully urge that this passage clearly establishes that references by the Marianowski et al. patent to coal gasification are merely as a source of mixed gases supplied to the reactor vessel of Fig. 3 disposed upstream of the reactor vessel and not as an integral part of the reactor vessel as argued by the Examiner.

Applicants are enclosing with this response a Declaration under 37 CFR 1.132 by Leonard G. Marianowski, one of the listed inventors of the Marianowski et al. patent. As indicated by Declarant, the apparatus of the Marianowski et al. patent cannot operate as a solid carbonaceous material reactor because the introduction of any solid carbonaceous material into the reactor would result in plugging of the catalyst material therein. Declarant further states that references to coal gasification such as appears at Col. 2, lines 59-65 of the Marianowski et al. patent merely indicate the potential sources of mixed gases to be introduced into the reactor vessel of Fig. 3. Accordingly, in view of the fact that the reactor vessel of the Marianowski et al. patent is not a carbonaceous material reactor vessel containing solid carbonaceous material as required by Applicants' claimed invention, Applicants respectfully urge that the Marianowski et al. patent does not render Applicants' claimed invention obvious in the manner required by 35 U.S.C. 102(b).

Claims 7 and 19 have been rejected under 35 U.S.C. 103(a) as being unpatentable over the Marianowski et al. patent in view of Edlund, U.S. Patent 5,139,541 (hereinafter "the Edlund patent"). This rejection is respectfully traversed. Applicants' arguments with respect to the Marianowski et al. patent as set forth herein above are equally applicable to this rejection and, thus, will not be repeated other than to reiterate that the Marianowski et al. patent neither teaches nor suggests a carbonaceous material reactor vessel for forming hydrogen containing solid carbonaceous material as required by Applicants' claimed invention. The Edlund patent teaches composite metal membranes that contain an intermetallic diffusion barrier which is a thermally stable inorganic proton conductor separating a hydrogen-permeable base metal and a hydrogen-permeable coating metal. The Edlund patent is relied upon by the Examiner for teaching an economically feasible membrane composition such as palladium coated $SrCe_{(1-x)}Yb_xO_z$ that accomplishes hydrogen separation at lower cost than palladium membranes. Claim 7 of the subject application recites a permeable hydrogen-selective membrane comprising a ceramic material of perovskite oxide having a formula

$$A_{1-x}A'_xB_{1-y}B'_yO_{3-z}$$

where A is selected from the group consisting of Ba, Sr, Ca and Mg, A' is selected from the group consisting of La, Pr, Nd, Gd, and Yb, B and B' are selected from the

group consisting of Ce, Nd, Sm, Eu, Gd, Tm, Yb and Y, O is oxygen, x and y are numbers in a range of 0 to 1, and z is a number sufficient to neutralize a charge in said perovskite oxide. Applicants note that palladium is *not* a component of the permeable hydrogen-selective membrane claimed by Applicants in the rejected Claim 7. Nor does the Edlund patent or the Marianowski et al. patent teach or suggest the use of ceramic materials of perovskite oxides for hydrogen separation in a solid carbonaceous material gasification reactor vessel as claimed by Applicants. Accordingly, Applicants respectfully urge that, based upon the teachings of the Edlund patent, one skilled in the art would not be motivated to use a membrane for hydrogen separation which did not include a metal known to be suitable for use in hydrogen separation. Even if the Edlund patent is deemed to teach the membrane of Claim 7 of the subject application as argued by the Examiner, given that the Marianowski et al. patent neither teaches nor suggests a carbonaceous material reactor vessel for forming hydrogen containing solid carbonaceous material as required by Applicants' claimed invention, Applicants respectfully urge that the combination of the teachings of the Marianowski et al. patent and the Edlund patent would not result in the invention claimed by Applicants. Accordingly, Applicants respectfully urge that the Marianowski et al. patent and the Edlund patent, alone or in combination, do not render Applicants' claimed invention obvious in the manner required by 35 U.S.C.

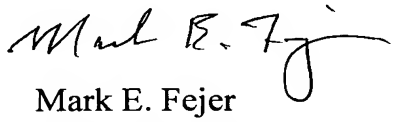
103(a).

Conclusion

Applicants intend to be fully responsive to the outstanding Office Action. If the Examiner detects any issue which the Examiner believes Applicants have not addressed in this response, Applicants urge the Examiner to contact the undersigned.

Applicants sincerely believe that this patent application is now in condition for allowance and, thus, respectfully request early allowance.

Respectfully submitted,



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